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ABSTRACT

Shared virtual worlds are innovative applications where several users, represented by Avatars, simultaneously access via Internet a 3D space. Users cooperate through interaction with the environment and with each other, manipulating objects and chatting as they go. Apart from in the well documented online action games industry, now often played out in real time over the Internet, the success stories of virtual worlds and shared VRML environments have been sporadic. Interest wanes from an enthusiastic beginning: the 3D world looks both enticing and promising, but the attention curve drops sharply as the users find the space either too difficult to navigate or not satisfyingly engaging. The key to the success or failure of these environments relates directly to the content offered and the ability of the environment to hold a critical mass of users in real time. This paper presents an innovative project, a shared virtual world geared to schools in an educational and highly structured environment. SEE,Shrine Educational Experience, is a cooperative project developed jointly by Shrine of the Book at the Israel Museum, Jerusalem, and the Politecnico di Milano, Italy, offering a pioneering educational environment based on a shared 3D virtual world, where classes from all over the world meet in order to learn and discuss issues related to the famous Dead Sea Scrolls and the tiny community (probably of Essenes) who once lived by the Dead Sea. Includes eight figures. (Contains 14 references.) (Author)

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The SEE Experience: Edutainment In 3D Virtual Worlds.

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Abstract

Shared virtual worlds are innovative applications where several users, represented by Avatars, simultaneously access via Internet a 3D space. Users co-operate through interaction with the environment and with each other, manipulating objects and chatting as they go. Apart from in the well-documented online action games industry, now often played out in real-time over the Internet, the success stories of virtual worlds and shared VRML environments have been sporadic. Interest wanes from an enthusiastic beginning: the 3D world looks both enticing and promising, but the attention curve drops sharply as the users find the space either too difficult to navigate or not satisfyingly engaging. The key to the success or failure of these environments relates directly to the content offered and the ability of the environment to *hold* a critical mass of users in real time. This is the desperately sought after magic social glue that determines the experience to be meaningful and actively keeps the users under its virtual spell.

The paper will present an innovative project, a shared virtual world geared to schools in an educational and highly structured,environment. SEE, Shrine Educational Experience, is a co-operative project developed jointly by Shrine of the Book at the Israel Museum, Jerusalem, and the Politecnico di Milano, Italy, offering a pioneering educational environment based on a shared 3D virtual world, where classes from all over the world meet in order to learn and discuss issues related to the famous Dead Sea Scrolls and the tiny community (probably of Essenes) who once lived by the Dead Sea.

Keywords: e-learning, 3D virtual worlds, edutainment

3D Worlds: A New Challenge to Museum Communication

Exactly two years ago, at Museums and the Web 2001 in Seattle, Susan Hazan of the Israel Museum, Jerusalem, and Professor Paolo Paolini and his team sat down for a micro-brain-storming session to think of a way to harness the impressive technology developed for their "Leonardo da Vinci" project (Barbieri, T., P. Paolini et al,. 1999) for the Israel Museum in Jerusalem. The teams soon focused on the idea of a real-time, educational scenario that would extend the museum's mission to educate and interpret collections for its online community, and the seed was sown.

The Education Department of the Israel Museum, Jerusalem, is proud of its track record of innovative, online educational activities. In 1996, during the exhibition, *Children of the World Draw Jerusalem at 3000*, the department developed an ambitious project to provide a unique opportunity for children from all parts of the globe to take part in a drawing contest on the theme of Jerusalem (Hazan, 1996). For the duration of the exhibition, the department set up three Macintosh computers. For six weeks they were staffed by high school students from our

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Multimedia Education Unit with a specially designed Web site that offered remote visitors the opportunity to upload their own artworks, to be displayed online, as well as to play an interactive trivia game to learn about Jerusalem, its history, geography and religions. A further opportunity to 'visit' the exhibition was made possible through a video window. Using the software CUSee-Me, the exhibition, with local visitors as spontaneous players on the live stage, was broadcast from the gallery for 8 hours a day for the full six weeks of the exhibitions, at the same time receiving remote visitors to the museum in real-time.

The exhibition *In the Light of the Menorah: Story of a Symbol*, was launched in 1998, a photo-realistic 3D gallery tour streamed at 15 frames per second over standard dial-up modems with embedded hyperlinks enabling students to interact with the movie (Hazan, 1999). This was an adaptation of a major temporary exhibition held at the Israel Museum, one which traced the manifold incarnations and interpretations of the seven-branched candelabrum from Biblical sacred object to national emblem, as represented in objects from the Museum's extensive collections of archeology, Judaica, and the fine arts. In the same year the Israel Museum forged a partnership with the Hebrew University and a number of Israeli cultural institutions in order to develop a specially devised Web site, *Galim*, meaning waves. Via the Museum@school project ,*Galim* students navigated the 3D environment through online games, quizzes and self-directed exploration, delivering a new museum experience straight into the classroom.

The museum was confident that if these two components, the real-time excitement of the video window and the challenge of wandering a 3D gallery online searching for clues, could be combined, the result could be a novel way of extending the museum's mandate to enhance and interpret its collections for remote visitors. The magic created by the Politecnico world for the Leonardo project appeared to present exciting new possibilities.

Games too turned out to be a powerful source of inspiration. *MechAssault*, billed as *fierce tactical combat and destruction, 31st-century style*, is now *Live*-enabled, meaning that the real-time component allows users to play with each other online as many of the action games already do, and even if youngsters are not out there shooting each other, or forming online strategies to blast each other out of the game, many of the online activities are just as superficial. The popular *The Sims Deluxe* (http://thesims.ea.com/), the latest and wildly popular version of the original *The Sims*, is promoted as *Create an entire neighborhood of Sims and run or ruin their lives*, while NFL Fever, the best-selling football game on X-Box, boasts *some of the most bone-crunching, realistic animation of any football video game to date*. Many less virulent environments have been developed using VRML. Clearly "*being there*" in a real-time interaction with other users does hold a potent attraction, but performing specific activities in shared 3D spaces has proved to be difficult and sometimes frustrating. Once users have negotiated the technological obstacles to enter the online environment, (with a fairly robust computer and speedy communication), the key to the success or failure of these environments directly relates to the content offered and the ability of the environment to *hold* a critical mass of users in the same space at the same time. This is the desperately sought after magic glue that makes the experience meaningful and actively keeps the users under its (virtual) spell. Clearly the museum is not considered a player in this ballpark but on the other hand, should the museum even want to be there? What can a content rich provider such as the museum, with an impressive track record for 'holding' its visitors in compelling educational scenarios, possibly offer this industry?

The Israel Museum made a decisive move into this new arena, selecting the most valuable and compelling of its wide ranging collections as the thematic core of the activity the world renowned Dead Sea Scrolls. The Dead Sea Scrolls are on permanent display at the Israel Museum, Jerusalem, in a stunning building designed by the American architects Armand Bartos and Frederick Kiesler. Dr Adolfo Roitman, Head of the Shrine of the Book and Curator of the Dead Sea Scrolls, brought together a team of museum educators and curators, as well as staff of the New Media Department, to explore the curatorial content of the SEE project developed from his museum expertise as author of the exhibition, *A Day at Qumran: The Dead Sea Sect and Its Scrolls* (Roitman, 1997) and in his role as

gatekeeper of the precious collections. The Shrine of the Book is located at the heart of the political and cultural center of the State of Israel, close to the *Knesset*, (Parliament), government offices, the Hebrew University, and the Supreme Court Building. A white, ceramic covered dome covers the galleries, which are two-thirds below the ground and house the permanent collection. The striking juxtaposition of the gentle curve of the dome and the black, angular, basalt wall, both stark yet opposing geometrical shapes, creates a stunning vista and contributes a unique architectural phenomenon to the Jerusalem horizon. This was the portal selected for the online virtual world, a space for the social and educational interaction to be staged. The magic of the virtual world was that other worlds could be brought into the constellation of this experience ,and so the ambience of Qumran could be brought into the historical narrative and into a new reality.

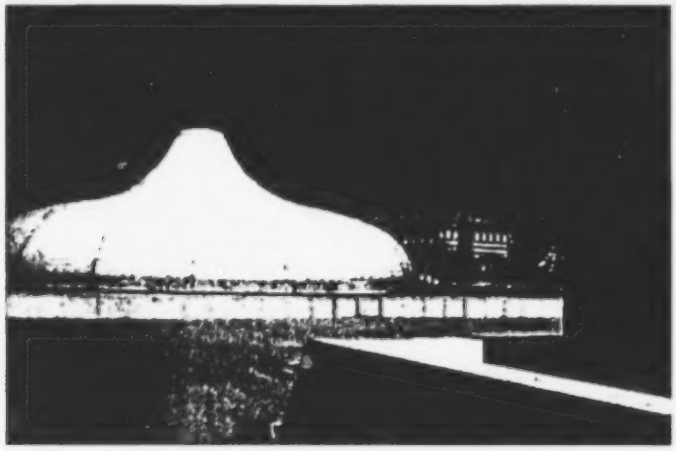

Fig. 1: The Shrine of the Book with the Knesset (Parliament)

The curatorial and educational team of the Shrine of the Book at the Israel Museum, Jerusalem, is concerned with preserving not only the material evidence of the scrolls themselves but also, just as important, the message contained within them. The SEE project, perhaps one of the first museum virtual worlds to be developed, is an exciting new and dynamic environment where objects can be manipulated and hidden portals accessed while avatars move around the shared space while socializing with each other in a real-time.

The Virtual Leonardo Project: Lessons Learned

Virtual Leonardo was deployed for the first time in 1999 (Barbieri, Paolini et al ii, 1999; Barbieri & Paolini, 2000) with a new version launched in 2001; it was developed by Politecnico di Milano for the Museum of Science and Technology, Leonardo da Vinci, in Milan.

The original objectives and the main features of the project are perceived as follows:

A 3D graphic environment to be used as a "container" to display "objects" of the museum.

Specific choices in our case were an "idealized" rendering of the cloisters of the museum (hosted in a former monastery) as the container, and the "Leonardo machines" the objects. The latter are 3D interactive objects, representing actual wood machines on display in the museum; the machines were built several decades ago in order to "render" ideas and concepts developed by Leonardo in several of his drawings.

Users are encouraged to visit the "virtual museum" in groups

The users are encouraged to visit the virtual museum in groups: a family, a group of friends, a school, and few visitors with or without an expert. This creates a sense of "not being alone" while visiting the museum, a factor that increases fun, engagement, and interaction, while making the overall visit more effective and rewarding.

Avatars represent users who are visiting the "virtual museum"

Users "visiting" the museum are actualized through avatars, i.e. graphic objects that appear as either real persons, or graphic renderings. The purpose of using avatars is twofold: it allows the users to perceive their own physical positions in the virtual space as well as to recognize other avatars' positions within the museum. Users move their Avatars in order to change their position within the museum or to make contact with the objects.

Advanced functions allow users to cooperate in several fashions

We realized, since the inception of the project, that providing "traditional" interaction mechanisms within the virtual museum was not sufficient. Traditional 3D environments allow users to chat, to interact with objects, and to wander around (using "real world" limitations, in general). We observed that in most 3D environments the above possibilities did not encourage a great deal of "cooperation" among users: chat was the main instrument of cooperation with the others, making avatars almost useless (i.e. not exploiting the spatial cooperation). We strongly felt this concern: how could we get the visitors to actually interact with each other, besides chatting? We therefore introduced the notions of "cooperation capabilities" and "cooperation metaphors". A cooperation capability defines something that users can do: e.g. move, speak to everybody, whisper to a few, change visualization point of view (using fixed cameras, for example), make hyper jumps, look through the eyes of someone else, etc. A cooperation metaphor (Barbieri & Paolini, 2001 the term "metaphor" is not really appropriate, but this was the term that we historically used)) is a combination of cooperation capabilities assigned to the different users, in order to obtain a specific overall behavior: e.g. during an "explanation" the "guide" can "speak" to all the visitors, while each visitor can speak only to the guide and not to the other visitors, and hyper jumps are not allowed. Cooperation metaphors were understood through the experience of *Virtual Leonardo*, but not fully exploited within it (more advanced use of cooperation metaphors has been introduced in later applications developed by Politecnico).

A "museum guide" takes the visitors around

We did realize very quickly that a group of "visitors" in a virtual museum, without a specific goal in mind or a task to perform, very likely would "hang around", without actually knowing what to do. Therefore we introduced the notion of "museum guide", with a number of duties:

- stimulating the curiosity of visitors
- organizing the visit
- providing additional information
- answering questions

If audio guides and "physical" guides are a popular option in a real museum, they are indispensable in a virtual museum for a number of reasons that are probably obvious to all virtual visitors who have experimented the feeling, "what am I going to do next?" and even more obvious when a group of visitors must be kept together for a meaningful visit.

Visiting a "virtual museum" becomes a "social" activity

Thinking about all these factors together and understanding that visiting a real museum alone is a different experience from visiting with other people (with family, friends, experts), made these lessons insightful in our future development of shared virtual worlds.

Virtual Leonardo has raised the interest of practitioners, researchers and the general public. Its simple idea is appealing to all: "*at this museum you can bring a date*", proclaimed the title of an article on New York Times online (Mirapaul 1999). So, the idea of visiting a virtual museum evolved rom a "one at a time" activity to a social activity.. Many users have visited *virtual Leonardo*, but we realized that there were some flaws regarding the three main aspects of the application: the interaction, the content, and the reproduction of the real world limitations. More specifically, we noted the following problems:

About the interaction:

- Visitors mainly interacted with the guides and the objects; there was little reason for a visitor to interact with another visitor.
- There was an inherent tradeoff between having the visitors spend their time interacting with the world and the objects or having them interact with each other.
- Despite the power of cooperation metaphors, it was still difficult (except in demos) to avoid avatars hanging around, while the focus of the interaction was the chat.

About the content:

- The 3D environment was not appropriate to deliver either large quantities of information or high quality visual information.
- If the main emphasis of the visit were to acquire new information, there would be limited opportunities to get to know other visitors.
- Whenever the visit was geared to emphasize discussion among visitors, clearly users should be supplied with enough material beforehand to be able to engage with the material during the session.

About the reproduction of the real world constraints:

- Mimicking the physical limitations of the real world turned out not to be useful in general, and quite boring in the end.

If the virtual visit to a museum is to provide a meaningful and forceful experience, something more structured and compelling is needed. Therefore, when the Israel Museum asked Politecnico to start to investigate a new project targeting high and junior high school pupils and focused around the Dead Sea Scrolls and Qumran, the Politecnico staff decided to create a completely new kind of experience built on the foundations of the *Virtual Leonardo* project.

The Shrine Educational Experience

For the new application, baptized "SEE" (Shrine Educational Experience), we chose high school and junior high school students as our target group. In the future, we are considering other target groups: such as tourists who are interested in the Holy Land, scholars who want to *meet* in the virtual world to discuss an issue related to Qumran and the Dead Sea Scrolls, or simply well educated *surfers*. The SEE experience is based on the interaction of four classes, from different parts of the world, virtually *meeting* in real-time in a 3D virtual environment, together with the museum guide. The 3D world consists of several different settings, including (Fig. 2) the internal and external (real) spaces of the Israel Museum's Shrine of the Book where the Scrolls are on display, while reiterating the potent symbolic metaphors of the buildings themselves (Fig. 3) set in contemporary Jerusalem, with a hyperlink to the Qumran desert, and the historical setting of the Essene community.

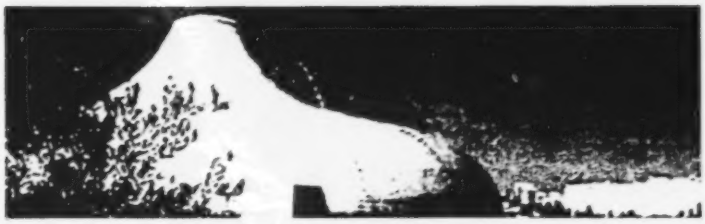

Fig. 2: The Israel Museum's Shrine of the Book

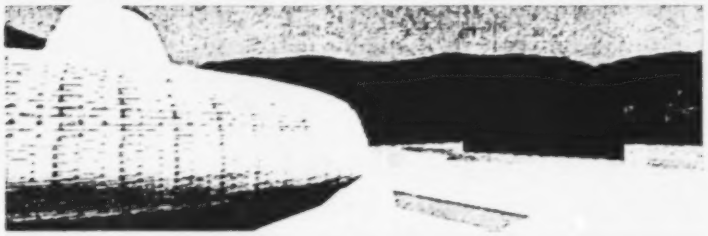

Fig. 3: A screenshot of the virtual Shrine external environment

The students are represented by avatars and move, play and interact in the virtual world. Meetings last about an hour, where content (made available in advance to schools via a tutorial Web site) is recollected and applied in the "cultural games". SEE thus offers an *edutainment* experience, where students engage with the cultural content while enjoying themselves at the same time. The entire SEE experience consists of 3 interactive sessions, where students are led to discover respectively (1) the Shrine of the Book Campus in the Israel Museum in Jerusalem, (2) the Essene community who once lived in Qumran, and (3) the connections between the Qumran community with other religions and culture.

When SEE was designed, four major requirements were considered:

1. The relevance of the cultural content, the knowledge about Qumran, and related issues,(religious, historical, technical, social, etc.).
2. The inter-cultural exchange through *meetings* in the virtual space, with students of different countries and/or of different cultures.
3. The interaction between physically remote participants in an innovative and engaging experience, through the virtual environments. The games that the students are invited to perform in also consolidate "team-ship", while forging new relationships and ties among different schools.
4. An acquaintance with state of the art Information and Communication Technologies and the possibility of integrating modern multimedia, graphic, Web and Internet technologies into the school program.

The design improvements were adapted while accommodating the above self-subscribed goals as well as through what we had learned through the *Leonardo* experience and consequently integrated into the SEE application.

From Leonardo to SEE

In this section we go through the three "weak points" spotted in the Leonardo project; that is, how to promote the interaction, how to deliver the content, and what constraints of the real world should be reproduced, showing how we tried to overcome them in planning the SEE experience.

Promoting the interaction

One of the well-known drawbacks of 3D worlds is that visitors very soon get bored of moving around the environment when there is little motivation to do so. If

their time is spent simply chatting with the others, this becomes an overall unsatisfying experience. Therefore we decided to carefully plan a set of activities through a storyboard to be acted out during the SEE experience, in order to avoid wasting precious online time or avatars hanging around aimlessly in corners.

Basically, each online session is divided into four main phases:

1. A brief moment of *Introduction*, during which students meet each other in the virtual environment and are welcomed by the Guide.
2. An *Exhibition* phase, in which either new content is delivered or already known material is recollected through boards (that is, pop-up browser windows showing multimedia content in a traditional, readable 2D format).
3. Two *Cultural Games* where students, divided into two teams, have to prove their ability in a multiple-choice quiz (one student per team must perform an ability-game in order to win the right of answering first for his team; fig. 4) as well as a Treasure Hunt (fig. 5) or matching-pairs game, both taking place within a specifically dedicated space, similar to a labyrinth.
4. Finally, the Guide gathers the students for a short *Wrap-up* where the key issues of the session are summed up, homework is assigned, and the next session's main theme is briefly anticipated.

Fig 4: Screenshot of an avatar approaching the first ability-game in the Quiz Space

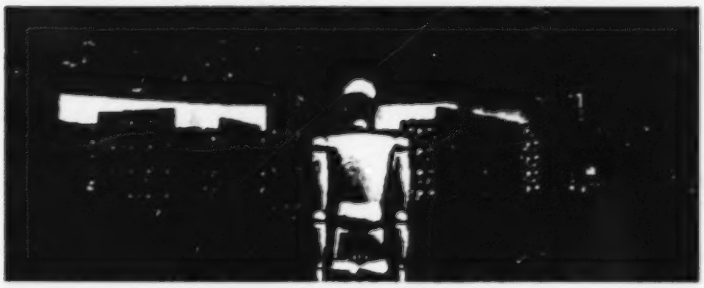

Fig 5: Screenshot of an avatar exploring the labyrinth during a Treasure Hunt

Our preliminary tests in schools have demonstrated that the *discipline* of the storyboard has the positive effect of offering students a sequence of tasks to perform, alternating with games and brief lectures and the question-answering sessions with the guide. The whole experience therefore is about following a brief - and is competitively exciting.

While we succeeded with *Virtual Leonardo* when visitors interacted with the objects, we failed in that they did not interact with each other apart from the chat.

Therefore in planning the SEE experience, one of our most important issues was to compel avatars to interact (1) with the environment, (2) with the objects, as well as (3) with each other.

As regards points (1) and (2), all the games were planned so as to compel students to actively use the environment features, even the most advanced of the virtual world. Avatars may fly, see from another avatar's point of view (using his or her own *eyes* or another's), or view the site from fixed cameras. For example, in the Treasure Hunt students move around in the environment and find the sets of objects related to each other. In the brief time allotted to this challenge, looking through another's eyes and from another's point of view can be very useful, and even imperative, in order to be able to compare the objects to see whether they match or not before their time is up. In the quiz, students have to perform ability games (such as jumping from one platform to another without falling, pushing geometrical objects into holes), to win the right to answer to the questions.

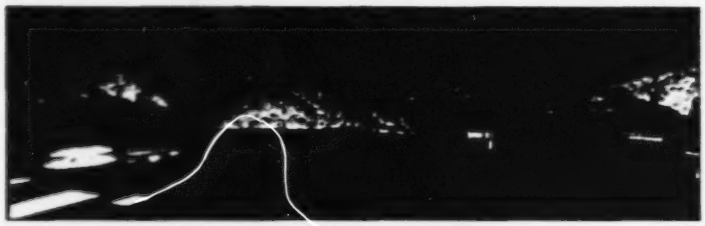

Fig. 6: Screenshot of the Quiz Space, an environment dedicated to one of the Cultural Games

In order to encourage avatars to collaborate with each other (point 3), to gain advantage in the games, students have to exchange opinions and really put their heads together. In the Treasure Hunt, for example, they have to check whether the object they've found matches the others, as all of the objects that the team needs to collect are semantically linked by a clue (i.e. *find all the objects that were used during the community's communal meal*). The quiz also encourages cooperation, for the right answer among three has to be spotted.

Tests in schools have shown that students love collaborating a team and interact not only for *strictly business* reasons as time is so short (find the correct answer, check the objects), but also to encourage their teammates with friendly messages to urge them on in the game.

Delivering cultural content

3D worlds are clearly not appropriate architectures for disseminating large amount of information, as neither lectures nor expansive documents work well with new means of communication. These limitations ironically encouraged creative cooperation and interaction among the visitors. Our challenge became therefore to match this simple observation with the educational goal of the application: how to deliver robust cultural content appropriate for a museum experience to students. Making background material available to schools through a *traditional* 2D site appeared to provide the solution, and the 2D site now functions as a gate to the 3D environment.

The background material provided consists of:

- Interviews with experts of the Dead Sea Scrolls and the Qumran community.
- Editorial insets explaining issues, events or characters in detail, mentioned by the experts in the interviews
- An anthology collecting all the excerpts from the Scrolls, the Bible, historical sources or other texts mentioned or quoted in the interviews

- Auxiliary didactic material providing background information on historical and geographical issues that may be obvious to some parts of the audience, and rather obscure to others (e.g. Israeli students know quite well where the Dead Sea is; for remote students this is not obvious at all).

Both the boards accessible though the 3D environment as well as the games themselves recall the relevant concepts and themes of the background material, summarizing a few key points and provoking online discussion with both the other participants and the guide.

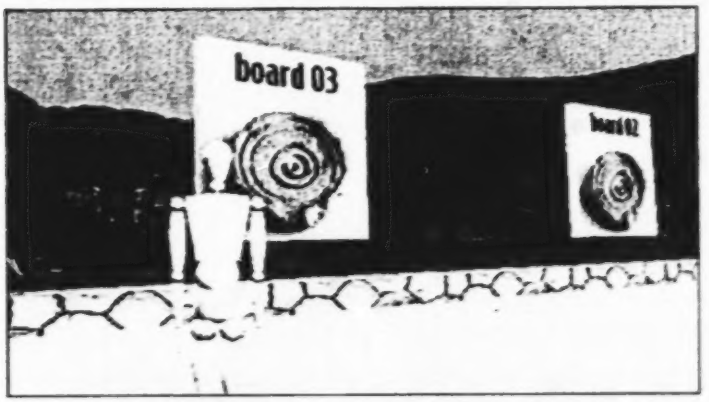

Fig. 7: The Guide's avatar near a board hotspot

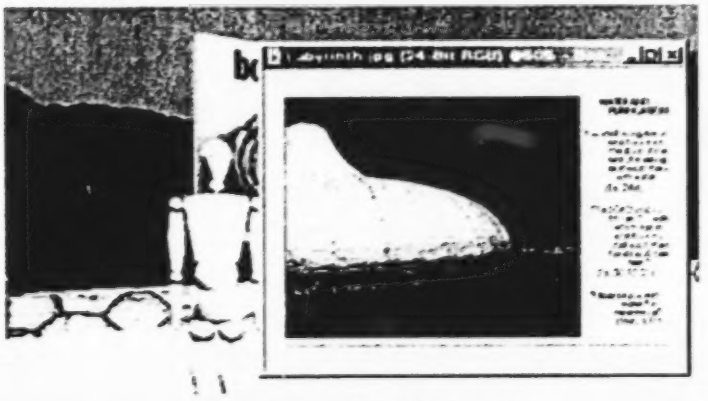

Fig. 8: Screenshot of a board

The core of the background material consists of interviews with scholarly experts on the Dead Sea Scrolls and the Qumran community. Interviews are readily available both in full text and in summary. The interview format was selected for a number of reasons:

- The format is more immediate and straightforward, if compared to standard schoolbooks.
- Interviews provided a platform for different ideological, religious and cultural points of view. We have already interviewed (and plan to interview in the future) experts representing all different cultural and religious points of view on Qumran and related issues: Hebrew, Christians of all denominations, Arabs, lay scholars. Students are thus allowed to compare different approaches on the same topic.
- The *virtual* debate among scholars in the interviews enhances critical thinking. In fact, many issues concerning the Dead Sea Scrolls are currently under debate (for example: is the Q7 fragment an early testimonial of the Gospel?). Instead of arbitrarily presenting and

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promoting one opinion among the others, we decided to create a sort of "virtual panel" among experts on the hottest topics.
- Students may compare different opinions of a number of experts while realizing that many issues have not yet been resolved. In "normal" schoolbooks, students are led to think that all the issues are settled once and for all, whilst real historical and scientific research presents large fields still to be explored!
- Students may discover the typical dynamic of research. This is the result of the above points.

Reproducing the Real World

The observation that students tend to interact mainly via chat has recently brought us to some theoretic developments concerning what we called "proxemics semiotics"; i.e. the investigation of the "signals" that human beings exchange in the real world, often because of the physical limitations of the real world itself. "Proxemics" derives from the Greek verb *pros-semaino*; that is, "to mean together with", to mean *a cot* of the main communication channel, that is, the verbal channel. Proxemics semiotics is being developed by a joint effort of USI (University of Italian Switzerland) and Politecnico di Milano, with the goal of creating a new generation of more effective 3D virtual spaces (Di Blas & Paolini, 2003). For example, if we enter a room in a museum and see that all the visitors are gathered around a specific work of art, we are led to think that this must be an especially important work, possibly the most important in the room. In the virtual world, we can eliminate any physical limitation: but in doing so, we also cancel all those signals that in the real world are so meaningful! If avatars can look at a board from any part of the environment, all the others will never notice that they are interested in that particular board, unless motivated to do so by the others via chat. Otherwise, if the avatars were compelled to approach an object or a board or another avatar in order to interact ,this intention would be made clear immediately to all the others. This is one of the reasons that the use of chat during the experience is so thick: many of the things that in the real world are self-evident, because of the proxemics, ihave to be stated explicitly in the virtual world through a verbal message (that is, via chat). Avatars wanting to attract the attention of another must first say: *I'm looking at board 3, near the stairs* before declaring the reason of (*the meaning of the white dome is amazing*!).

We are currently considering which of the physical limitations of the real world should be maintained (or maybe somehow *translated*) in the 3D world, in order to enrich the overall communication and also to move it from the now almost exclusive chat-channel to the proxemics channel .We look forward to developing this exciting project in the near future.

Conclusions

SEE provides an educational experience centered on a Museum, with a number of distinctive features and innovative aspects:

- There is a blend of offline activities (background preparation, homework, etc.) and online activities.
- Online activities are a blend of "traditional" one-at-a-time navigation and cooperative activities.
- Cooperative activities emphasize the engagement of meeting other people and interacting with them. Information gathering is performed either offline (reading downloaded documents) or online.
- Background material is mainly based upon interviews, therefore purposely non systematic, possibly incomplete and inconsistent (sometimes experts have different opinions about interpretations or facts). The goal is to encourage students to understand the contradictions and the inconsistencies of the "real world" as opposed to the apparent and fictitious "cleanness" of textbooks.
- Via the background material and online experiences, students are led to correlate museum objects (i.e. the scrolls) and ancient culture to contemporary life, beliefs and experiences.

- The 3D environment is used with a well-defined storyboard (defining the sequence of scenes and of actions within the scenes), in order to keep the students "engaged" and under control.
- Competition (with the natural desire of winning) is used in order to encourage cultural preparation of the students.
- Gaming ability is also necessary to win; therefore students (rather than teachers) are encouraged to learn how to use advanced 3D-cooperation features.
- Last, but not least, the interaction among students of different cultures and backgrounds (with all the dangers of conflict always possible) is a major goal of the overall experience.

We are now working with very successful experimental usage (in Italy and Israel) and we will make SEE accessible world-wide in the fall of 2003. Only real-life usage will tell us whether our objectives were actually met or not

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